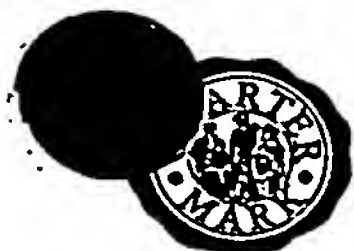


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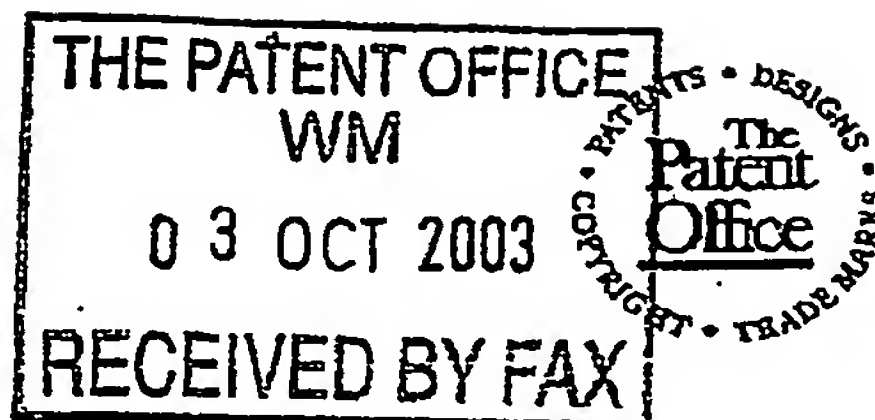
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1. Your reference	P35146-NGR/GMU		
2. Patent application number (The Patent Office will fill this part in)	0323174.3		- 3 OCT 2003
3. Full name, address and postcode of the or of each applicant (underline all surnames)	Joe O'Connor 18 Cregglea Claudy Co Londonderry BT47 4HU Northern Ireland		
Patents ADP number (if you know it)			
If the applicant is a corporate body, give the country/state of its incorporation	8727059001		
4. Title of the invention	"Variable Vibrator Mechanism"		
5. Name of your agent (if you have one)	Murgitroyd & Company		
"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)	165-169 Scotland Street Glasgow G5 8PL		
Patents ADP number (if you know it)	1198015		
6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.	Country	Priority application number (if you know it)	Date of filing (day / month / year)
7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note f)	Number of earlier UK application		Date of filing (day / month / year)
8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request?	No		
Answer YES if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. Otherwise answer NO (See note d)			

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9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form -

Description 16 ✓

Claim(s) -

Abstract -

Drawing(s) 9 only ✓

10. If you are also filing any of the following, state how many against each item.

Priority documents -

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Statement of inventorship and right to grant of a patent (Patents Form 7/77) -

Request for a preliminary examination and search (Patents Form 9/77) -

Request for a substantive examination (Patents Form 10/77) -

Any other documents (please specify) -

11. I/We request the grant of a patent on the basis of this application.

Signature(s)

Murgitroyd & Co.

Date 3 October 2003

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom

Craig Hutchison
0141 307 8400
craig.hutchison@murgitroyd.com

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1 Variable Vibrator Mechanism

2

3 The present invention relates to a variable vibrator
4 mechanism for use in machinery, especially, but not
5 exclusively, for use in vibrating screen and
6 vibrating feeder machines in the re-cycling and
7 quarrying industries.

8

9 Conventional vibrator mechanisms used in vibrating
10 horizontal screens and vibrating feeders operate on
11 the principal of eccentric weights located on
12 counter rotating shafts which generate a resultant
13 vibration of the mechanism which is translated to
14 the screens and feeders. The amplitude and
15 direction of the resultant vibration can be altered
16 to suit the characteristics of feed material by
17 varying the rotational displacement between the
18 eccentric weights and/or varying the mass of the
19 eccentric weights. Altering the amplitude and
20 direction of the resultant vibration of the
21 mechanism involves stopping the machinery, removing
22 the covers of the drive mechanisms, and physically

1 changing the rotational displacement and/or mass of
2 the weights. This typically involves between four
3 and eight hours work by two skilled technicians,
4 with an inherent safety risk due to nature of the
5 drive mechanism, along with a loss of production due
6 to the downtime of the machine.

7

8 It is an object of the present invention to provide
9 a vibrator mechanism which obviates or mitigates one
10 or more of the disadvantages referred to above.

11

12 According to a first aspect of the present invention
13 there is provided a variable vibrator mechanism
14 comprising:

15 a first member and a second member arranged
16 telescopically with one another,

17 wherein said first member has a first eccentric
18 weight and said second member has a second eccentric
19 weight,

20 wherein said first and second members are
21 adapted to be engaged with one another, such that
22 the rotational displacement between said first
23 eccentric weight and said second eccentric weight
24 may be varied by varying the longitudinal
25 displacement between said first and second members.

26

27 Preferably, the second member is adapted to
28 telescopically receive the first member.

29 Alternatively, the first member is adapted to
30 telescopically receive the second member.

31

1 Preferably, the first and second members are adapted
2 to be threadably engaged with one another.

3

4 Preferably, the first and second members are
5 cylindrical.

6

7 Preferably, the variable vibrator mechanism
8 comprises two first members.

9

10 Preferably, the means for telescopically engaging
11 the first and second members is a hydraulic ram.
12 Alternatively, the means for telescopically engaging
13 the first and second members is mechanically driven
14 shaft.

15

16 Preferably, the variable vibrator mechanism
17 comprises a plurality of first and second members
18 arranged telescopically with one another. More
19 preferably, the variable vibrator mechanism
20 comprises two first and second members arranged
21 telescopically with one another. More preferably,
22 the variable vibrator mechanism comprises three
23 first and second members arranged telescopically
24 with one another.

25

26 Preferably, the variable vibrator mechanism is
27 constructed of metal.

28

29 According to a second aspect of the present
30 invention, there is provided a vibrating feeder
31 machine including a variable vibrator mechanism in

1 accordance with the first aspect of the present
2 invention.

3

4 According to a third aspect of the present
5 invention, there is provided a vibrating horizontal
6 or inclined screen machine including a variable
7 vibrator mechanism in accordance with the first
8 aspect of the present invention.

9

10 Embodiments of the present invention will now be
11 described, by way of example only, with reference to
12 the accompanying drawings, in which:-

13

14 Fig. 1 is a perspective exploded view of a variable
15 vibrator mechanism in accordance with the present
16 invention;

17 Fig. 2 is a perspective view of an assembled
18 variable vibrator mechanism;

19 Fig. 3 is a perspective view of a variable vibrator
20 mechanism of Fig. 2 further including an outer
21 bearing, housing and cap plate;

22 Fig. 4 is a perspective view of a variable vibrator
23 mechanism of Fig. 3 further including a drive gear;

24 Fig. 5 is a perspective view of a variable vibrator
25 apparatus including three variable vibrator

26 mechanisms of Fig. 4;

27 Fig. 6 is a cross-sectional view of the variable
28 vibrator apparatus of Fig. 5 along line I-I of Fig.
29 5;

30 Fig. 6a is an enlarged view of one end of the
31 variable vibrator mechanism of Fig. 6;

1 Fig. 7a is a schematic end view of the variable
2 vibrator mechanism of Fig. 2, wherein the eccentric
3 weights of the first and second members are
4 rotationally offset to a maximum position from one
5 another;

6 Fig. 7b illustrates the operation of three counter
7 rotating variable vibrator mechanisms of Fig. 7a,
8 and shows the resultant displacement of the
9 vibration at each quarter turn of rotation;

10 Fig. 7c illustrates the resultant vibration path of
11 Fig. 7b;

12 Fig. 8a is a schematic end view of the variable
13 vibrator mechanism of Fig. 2, wherein the eccentric
14 weights of the first and second members are
15 rotationally offset to a minimum position from one
16 another;

17 Fig. 8b illustrates the operation of three counter
18 rotating variable vibrator mechanisms of Fig. 8a,
19 and shows the resultant displacement of the
20 vibration at each quarter turn of rotation;

21 Fig. 8c illustrates the resultant vibration path of
22 Fig. 8b;

23 Fig. 8d illustrates the range of vibration paths
24 available between the maximum and minimum vibration
25 paths of Figs. 7c and 8c; and

26 Fig. 9 is a perspective view of the variable
27 vibrator apparatus of Fig. 5 as attached to a
28 typical vibrating horizontal screen.

29

30 Referring to Fig. 1, a variable vibrator mechanism
31 10 comprises a pair of first members 12 and a second
32 member 14 arranged telescopically with one another.

6

1 That is to say the pair of first members 12 and the
2 second member 14 are arranged to be received wholly
3 or partly within one another.

4

5 The second member 14 is substantially cylindrical
6 with a second eccentric weight 16 located on its
7 outer circumferential surface 18 and two opposite
8 spiral keyways 20 (see Fig. 6) cut into its inner
9 circumferential surface 24. That is to say the

10 second member 14 has a weight 16 which is offset
11 from its central axis.

12

13 The first members 12 are also substantially
14 cylindrical with first eccentric weights 26 located
15 on their inner circumferential surfaces 28 and
16 spigots 30 located on their outer circumferential
17 surfaces 32. The first members 12 are also provided
18 with bores 34 therethrough.

19

20 The first members 12 are rotatably mounted on
21 hydraulic ram shafts 36a by bearings 38. The
22 bearings 38 are mounted on the ram shafts 36a within
23 the bores 34 of the first members 12 and each is
24 held in place with respect to the first member 12 by
25 a first circlip 42 and a shoulder 13 on the first
26 member 12, seen most clearly in Figs. 6 and 6a.
27 Each bearing 38 is located on the ram shaft 36a by
28 two second circlips 44, also seen most clearly in
29 Figs. 6 and 6a. Arranging the bearings 38, first
30 circlips 42 and second circlips 44 in this manner
31 prevents any longitudinal movement of the first
32 members 12 on the hydraulic ram shafts 36a.

1
2 The hydraulic rams 36 comprise a piston shaft 36a
3 and a piston housing 36b (as best illustrated in
4 Fig. 6). The piston housings 36b further comprise
5 hydraulic inlet and outlet ports 36c. The inlet and
6 outlet ports 36c facilitate the hydraulic operation
7 of the piston shafts 36a.

8
9 The piston housings 36b are surrounded by end stubs
10 46 which rotate with the second member 14. The
11 hydraulic rams 36 and the end stubs 46 are sealed to
12 each other by radial shaft seals 48 which are
13 mounted in housings 50, so that the end stub 46 can
14 rotate relative to the piston housing 36b. Housings
15 50 are located and fixed in recesses 52 of the end
16 stubs 46. The end stubs 46 are substantially
17 cylindrical with flange portions 54 secured to the
18 second member 14.

19
20 The right hand end stub 46 in Fig. 6 is fixed to a
21 drive gear 68 and is fixed longitudinally with
22 respect to its corresponding ram 36, while the left
23 hand end stub 46 in Fig. 6 is free to move
24 longitudinally with respect to its corresponding ram
25 36, to allow for thermal expansion.

26
27 Referring to Figs. 6 and 6a, the outer surface of
28 each ram 36 has a flange 136 which is connected to a
29 ram mounting plate 138 by bolts or the like, which
30 in turn is bolted to the outer cover 78. In this
31 way the hydraulic ram housing 36b is fixed and the
32 ram shaft 36a is free to move under hydraulic

1 control axially with respect to the housing 36b. It
2 is to be understood that variations in the ram
3 arrangement are possible so that the ram shaft 36a
4 is fixed and the housing 36b moves, with appropriate
5 redesign of the ram 36 and connections, as will be
6 understood by the skilled person.

7

8 The variable vibrator mechanism 10 comprises a set
9 of two first members 12 and hydraulic ram shaft

10 assemblies 36 to ensure balance across the vibrator
11 mechanism during operation. Spiral keyways 20 are
12 oppositely cut into the second member 14 to ensure
13 that the movement of the first members 12 along the
14 second member 14 is balanced.

15

16 With reference to Figs. 1 and 2, the first members
17 12 and the hydraulic ram shaft assemblies 36 are
18 mounted within the second member 14 by firstly,
19 locating the spigots 30 of the first members 12
20 within the spiral keyways 20 of the first member 14,
21 and secondly, by securing the end caps 46 to the
22 first member 14 by bolts (not shown), or other
23 fixing means, located on the outer edges 56 of
24 flange portions 54.

25

26 As illustrated in Fig. 3, an outer bearing housing
27 58 is fitted to one end of the variable vibrator
28 mechanism 10. The outer bearing housing 58 includes
29 an outer bearing 60 which is located in a recess 62
30 of the outer bearing housing 58 and held in place by
31 a cap plate 64. The cap plate 64 is fixed to the
32 outer bearing housing 58 by bolts (not shown), or

1 other fixing means. A radial shaft seal 66 is
2 fitted into a recess in the cap plate 64, whilst an
3 o-ring (not shown) is fitted between the outer
4 bearing housing 58 and the cap plate 64.

5
6 As illustrated in Fig. 4, a drive gear 68 is fitted
7 over the outer bearing housing 58 and held in place
8 by fixing bolts (not shown), or other fixing means.
9 The drive gear 68 butts against the corresponding
10 end stub 46 and is prevented from longitudinal
11 movement thereto. A radial seal 66 seals between
12 the drive gear 68 and the cap plate 64, whilst an o-
13 ring 70 seals between the drive gear 68 and the end
14 stub 46.

15
16 The complete vibrator apparatus 72 is illustrated in
17 Fig. 5. As shown, the complete vibrator apparatus
18 72 comprises three variable vibrator mechanisms 10
19 arranged in a row. The variable vibrator mechanisms
20 10 are mounted to the vibrator housing 74 by means
21 of bolts (not shown) between the outer bearing
22 housing 58 and the vibrator housing 74. An o-ring
23 (not shown) is fitted between the outer bearing
24 housing 58 and the vibrator housing 74. The
25 complete vibrator apparatus 72 further comprises a
26 cover 76 which encases the drive gears 68, and a
27 screen 80 which carries the feed material (not
28 shown) which is connected to the complete variable
29 vibrator apparatus 72. Although the complete
30 vibrator apparatus 72 is illustrated as comprising
31 three variable vibrator mechanisms 10, it should be
32 noted that it may contain any number of variable

10

1 vibrator mechanisms 10. The variable vibrator
2 apparatus 72 is driven, and thus the variable
3 vibrator mechanisms 10 rotated, in a conventional
4 manner by driving one of the mechanisms 10. Fig. 9
5 shows an example of a manner of driving. A
6 hydraulic motor (not shown) drives a driver pulley
7 90 on arm 94, which in turn uses a drive belt (not
8 shown) to drive a driven pulley 92 fitted to a
9 mechanism 10 to drive the end stub 46.

10
11 Fig. 6 is a cross-sectional view of a variable
12 vibrator mechanism 10 within the complete vibrator
13 apparatus 72 along line I-I of Fig. 5, and Fig. 6a
14 is an enlarged view of one end of the variable
15 vibrator mechanism 10 of Fig. 6. Fig. 6 shows the
16 two opposite spiral keyways 20 of the second member
17 14. Fig. 6 also shows the internal operation of the
18 hydraulic ram shafts 36. As seen in Fig. 6, when
19 hydraulic pressure is applied to the piston housing
20 36b, via inlet ports 36c, the piston shafts 36a move
21 the first members 12 towards the centre of the
22 second member 14. As this happens the first and
23 second members 12 and 14 threadably engage. The
24 spigots 30 follow the spiral keyways 20 and rotate
25 the first members 12 about the hydraulic ram shafts
26 36, thus varying the rotational displacement between
27 the first and second eccentric weights 26 and 16.
28 The piston shafts 36a and first members 12 are moved
29 back to the edges of the second member 14 by
30 reversing oil flow from the piston housing 36b via
31 outlet ports 36c.

32

1 The hydraulic ram shafts 36 may include conventional
2 remotely operated activation units (not shown) for
3 moving the first members 12 into and out of the
4 second member 14. These method of remotely
5 operating a hydraulic system such as this is known
6 and no further explanation is given here.

7
8 The operation of the complete vibrator apparatus 72
9 will now be described with reference to Figs. 7a -
10 8d. In this configuration the first eccentric
11 weight 26 is termed the variable weight and the
12 second eccentric weight 16 is termed the fixed
13 weight.

14
15 Fig. 7a is a schematic end view of a variable
16 vibrator mechanism 10 with the first and second
17 eccentric weights 26 and 16 of the first and second
18 members 12 and 14 rotationally offset from one
19 another by approximately 90 degrees. In this
20 embodiment of the present invention, 90 degrees is
21 the maximum rotational offset between the first and
22 second eccentric weights 26 and 16. However, it
23 should be noted that first and second eccentric
24 weights 26 and 16 may be offset from one another by
25 any angle.

26
27 Fig. 7a illustrates the centripetal force components
28 acting on the first and second eccentric weights 26
29 and 16 when the variable vibrator mechanism 10 is
30 rotating. The centripetal force component of the
31 first eccentric weight 26 is given the symbol "v"
32 (variable), and the centripetal force component of

1 the second eccentric weight 16 is given the symbol
2 "F" (fixed). Also shown is the overall resultant
3 centripetal force component acting on the variable
4 vibrator mechanism 10. This resultant component is
5 given the symbol "R" (resultant).

6
7 Fig. 7b illustrates the operation of the three
8 variable vibrator mechanisms 10 of Fig. 7a. As seen
9 in Fig. 7b, the first and third variable vibrator

10 mechanisms 10 rotate clockwise, whilst the second
11 variable vibrator mechanism 10 rotates counter-
12 clockwise.

13
14 The four rows in Fig. 7b each illustrate the
15 resultant displacement vibration component after a
16 quarter-turn of the variable vibrator mechanisms 10.

17
18 The overall effect of having three counter-rotating
19 variable vibrator mechanisms 10 is to map out a
20 vibration path which is elliptical, as illustrated
21 in Fig. 7c.

22
23 Fig. 8a is a schematic end view of a variable
24 vibrator mechanism 10 with the first and second
25 eccentric weights 26 and 16 of the first and second
26 members 12 and 14 rotationally offset from one
27 another by a minimal amount.

28
29 Again, Fig. 8a illustrates the centripetal force
30 components acting on the first and second eccentric
31 weights 26 and 16 when the variable vibrator
32 mechanism 10 is rotating. In this configuration the

1 overall resultant centripetal force component acting
2 on the variable vibrator mechanism 10 is greater
3 than the previous configuration where the first and
4 second eccentric weights 26 and 16 were rotationally
5 offset from one another by approximately 90 degrees.

6
7 Fig. 8b illustrates the operation of the three
8 variable vibrator mechanisms 10 of Fig. 8a. As seen
9 in Fig. 8b, again the first and third variable
10 vibrator mechanisms 10 rotate clockwise, whilst the
11 second variable vibrator mechanisms 10 rotates
12 counter-clockwise.

13
14 Again, the four rows in Fig. 8b each illustrate the
15 resultant displacement vibration component after a
16 quarter-turn of the variable vibrator mechanisms 10.

17
18 Fig. 8c again illustrates the overall elliptical
19 vibration path. In this configuration the resultant
20 vibration path is greater than the previous
21 configuration where the first and second eccentric
22 weights 26 and 16 were rotationally offset from one
23 another by approximately 90 degrees.

24
25 The configuration of the first and second eccentric
26 weights 26 and 16 of Fig. 7a results in a minimum
27 vibration path, whereas the configuration of the
28 first and second eccentric weights 26 and 16 of Fig.
29 8a results in a maximum vibration path. The
30 vibration paths available between these two
31 configurations, the maximum vibration path 7a and

1 the minimum vibration path 7b, are illustrated in
2 Fig. 8d.

3

4 Fig. 9 illustrates the complete vibrator apparatus
5 72 of Fig. 5 as applied to a typical vibrating
6 horizontal screen 80. As seen in Fig. 9, the cover
7 76 is cut-away to show a typical drive pulley
8 arrangement. The vibrating screen 80 operates in a
9 conventional manner which is known, and as such no

10 further description will be given here.

11

12 The preferred material of construction for all metal
13 components of variable vibrator mechanism 10 is mild
14 steel or cast iron.

15

16 The variable vibrator mechanism 10 therefore
17 obviates or mitigates the disadvantages of previous
18 proposals by providing a vibrator mechanism whose
19 vibration characteristics can be varied remotely
20 without having to stop and disassemble the machinery
21 and change the rotational displacement between fixed
22 and variable weights or add/remove mass to the
23 weights. The variable vibrator mechanism 10 avoids
24 the need for skilled technicians, removes the
25 inherent safety risk and avoids the loss of
26 production due to downtime of the machine.

27

28 Modifications and improvements may be made to the
29 above without departing from the scope of the
30 present invention. For example, although the
31 variable vibrator mechanism 10 has been described
32 above as comprising a pair of first members 12, it

1 should be appreciated that the variable vibrator
2 mechanism 10 could comprise any number of first
3 members 12, including a single first member 12.
4 Although the variable vibrator mechanism 10 has been
5 described above as being used in a three mechanism
6 apparatus, it should be appreciated that any number
7 of variable vibration mechanism 10 could be used in
8 a vibrator apparatus. Also, although the variable
9 vibrator mechanism 10 has been described as
10 comprising hydraulic ram shafts 36 which
11 rotationally offsets the first eccentric weight 26
12 from the second eccentric weight 16, it should be
13 appreciated that any means could be used to provide
14 this function, e.g. the hydraulic ram shafts 36
15 could be replaced with a threaded shaft which moves
16 into the second member 14 as it is rotated.
17 Furthermore, although the variable vibrator
18 mechanism 10 has been described above as having
19 first and second eccentric weights 26 and 16 which
20 can be rotationally offset from one another by
21 between approximately 0 degrees and 90 degrees, it
22 should be appreciated that these weights could be
23 offset from one another by any angle. Also,
24 although the variable vibrator mechanism 10 has been
25 described above having the first members 12 mounted
26 within the second member 14, it should be
27 appreciated that the first members 12 may
28 alternatively be mounted on the outer
29 circumferential surface, that is to say the first
30 members 12 telescopically receive the second member
31 14. Finally, although the variable vibrator
32 mechanism 10 has been described above as being

16

1 applied to vibrating horizontal screens, it should
2 be appreciated that the variable vibrator mechanism
3 10 could be applied to other machines which require
4 a vibration to be created from the rotation of
5 eccentric weights e.g. inclined screens, other
6 screens, vibrating feeder machines and road surface
7 hammering devices.

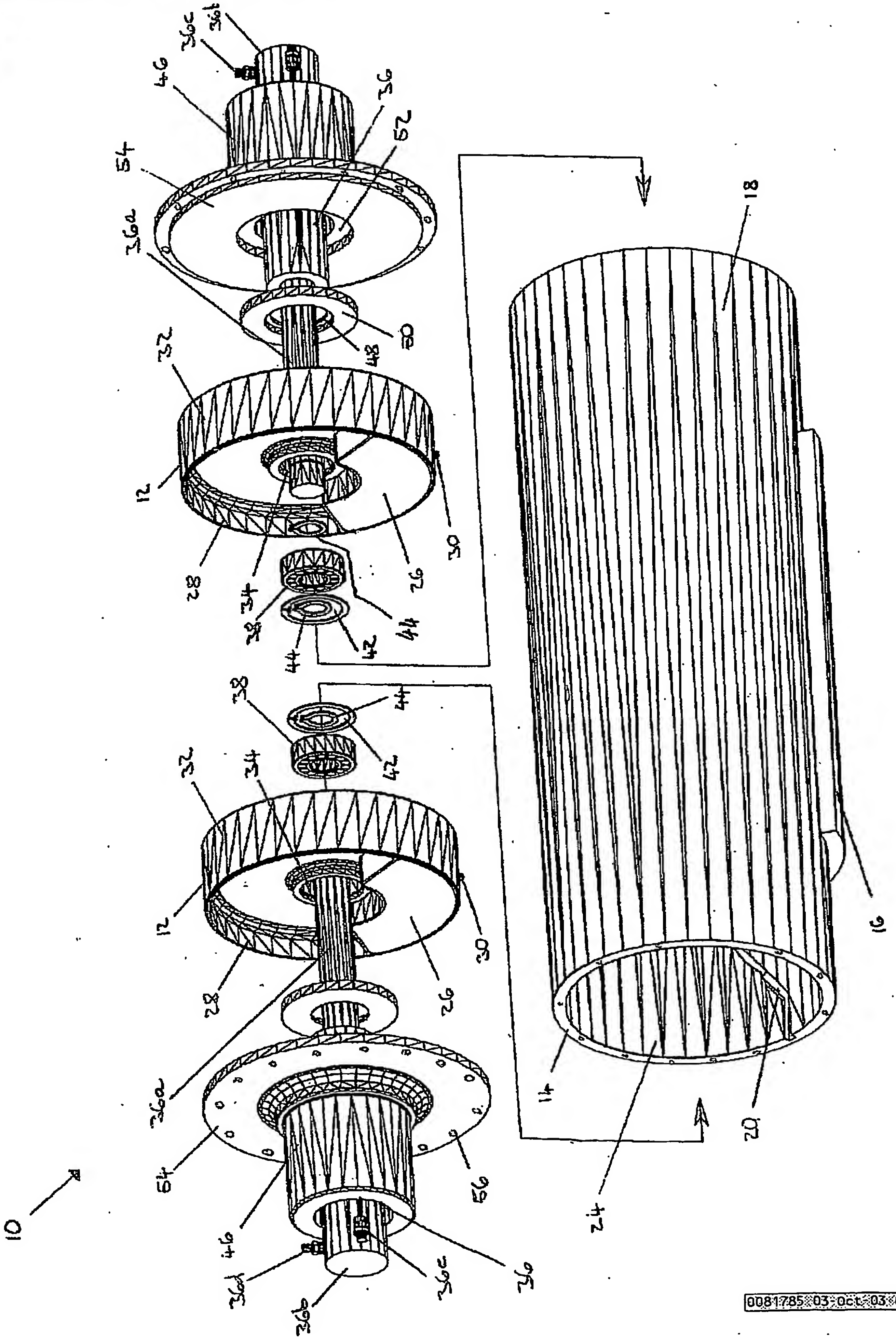


Fig. 1

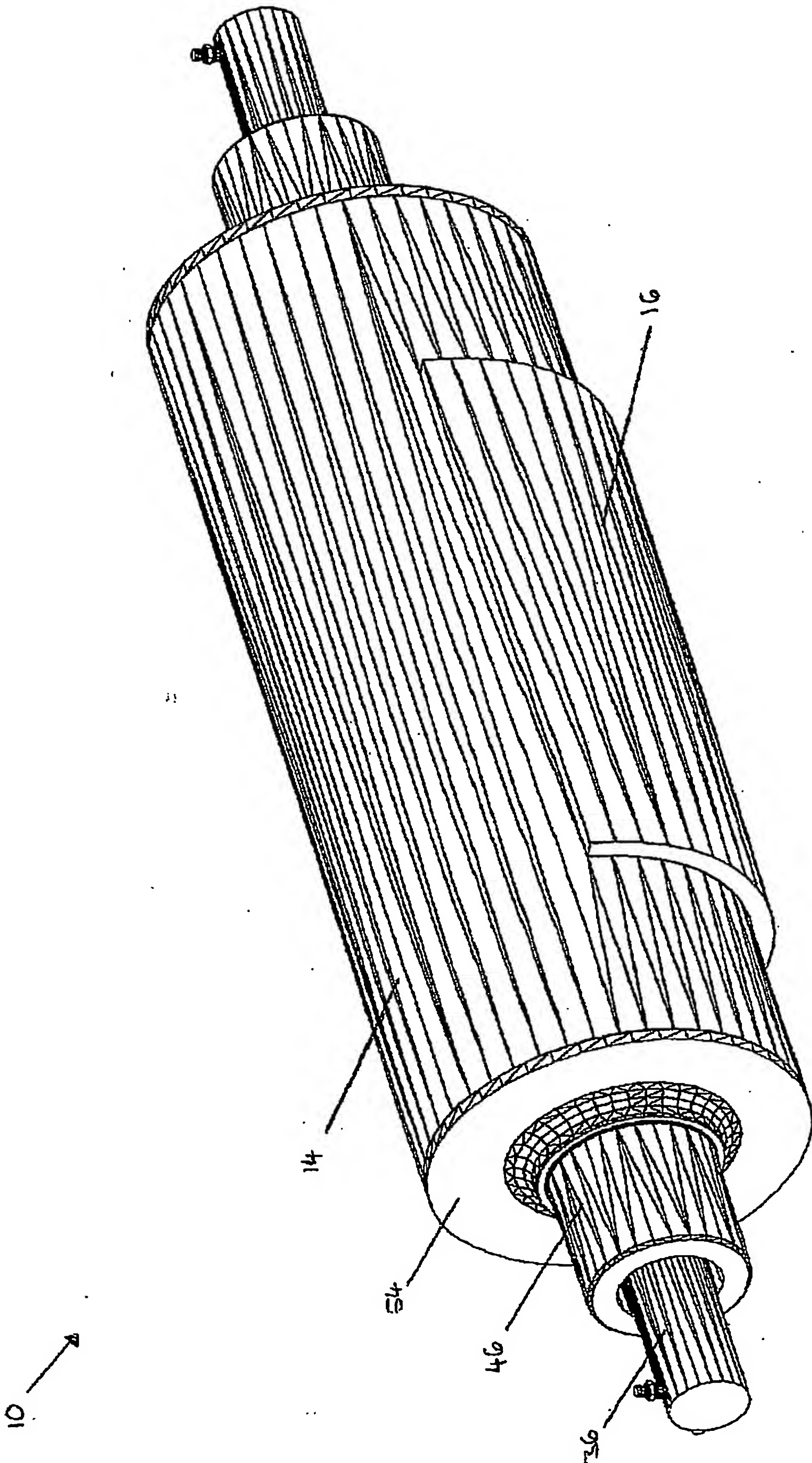


Fig. 2

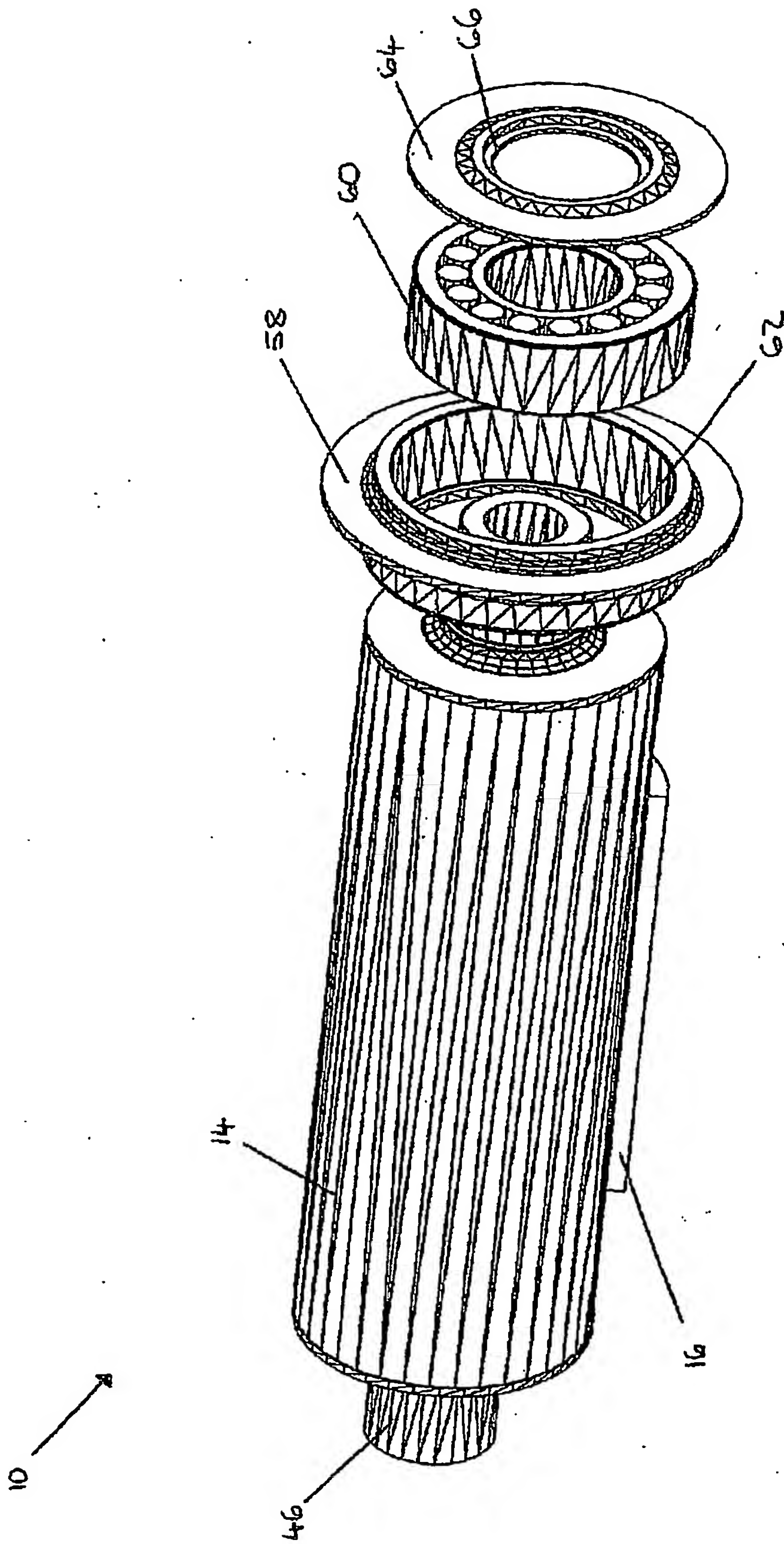


Fig. 3

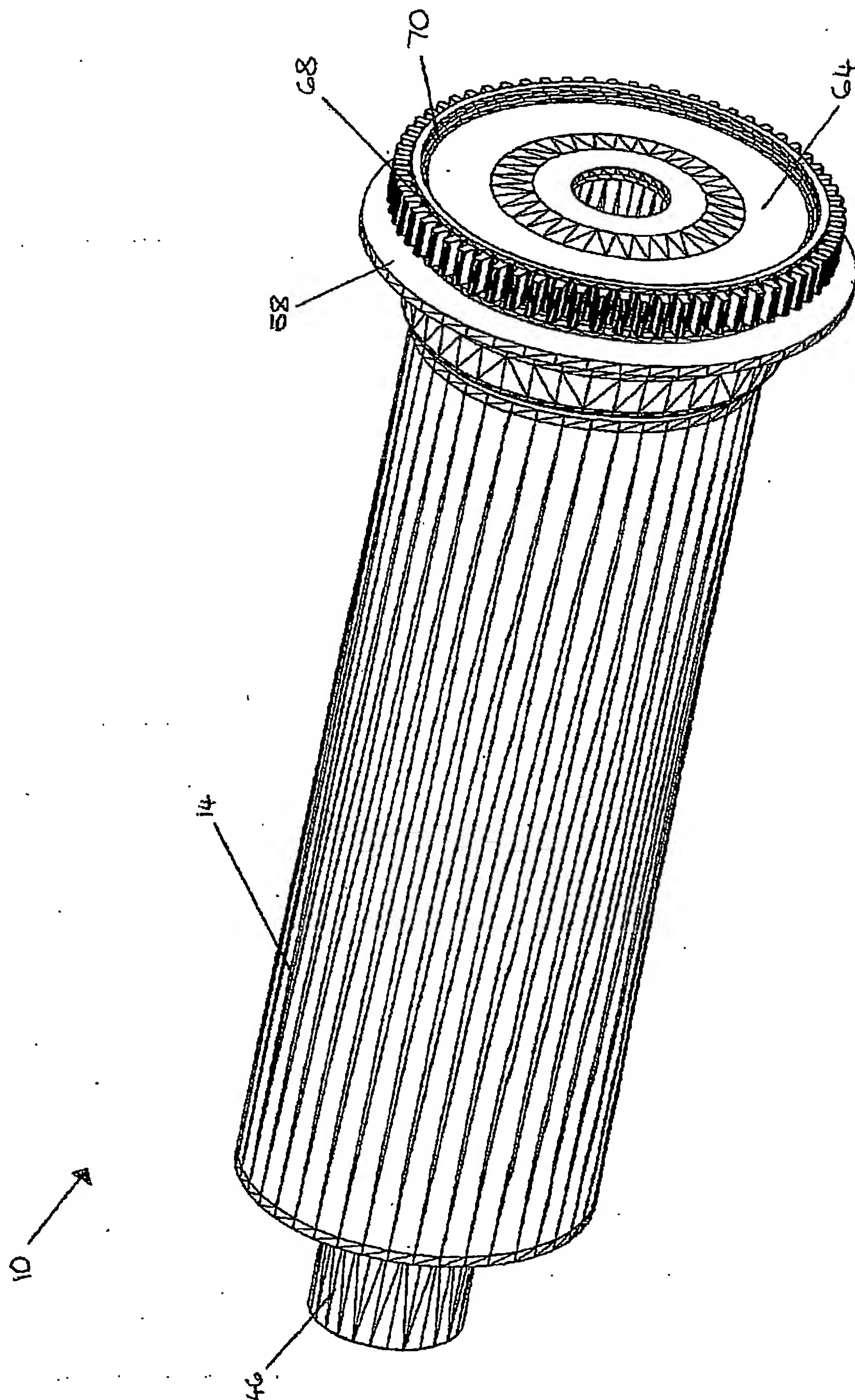


Fig. 4

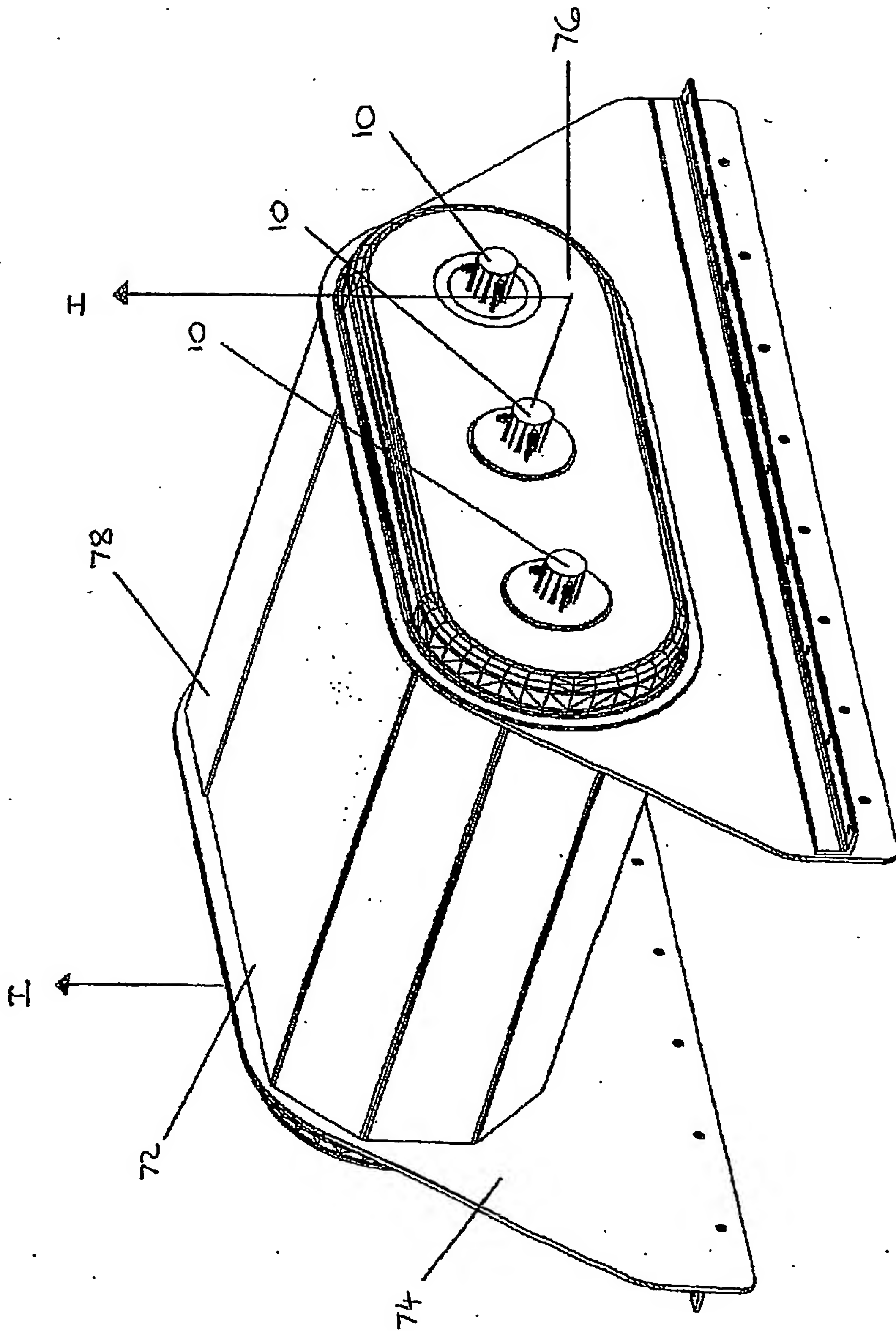


Fig. 5

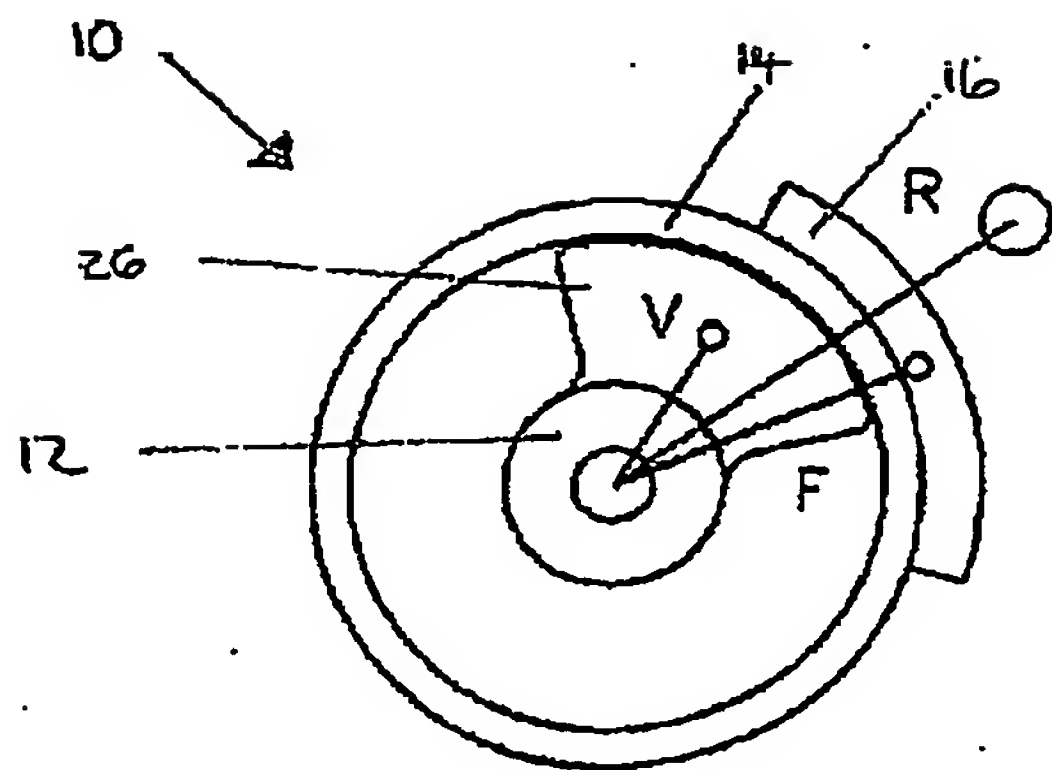


Fig. 8a

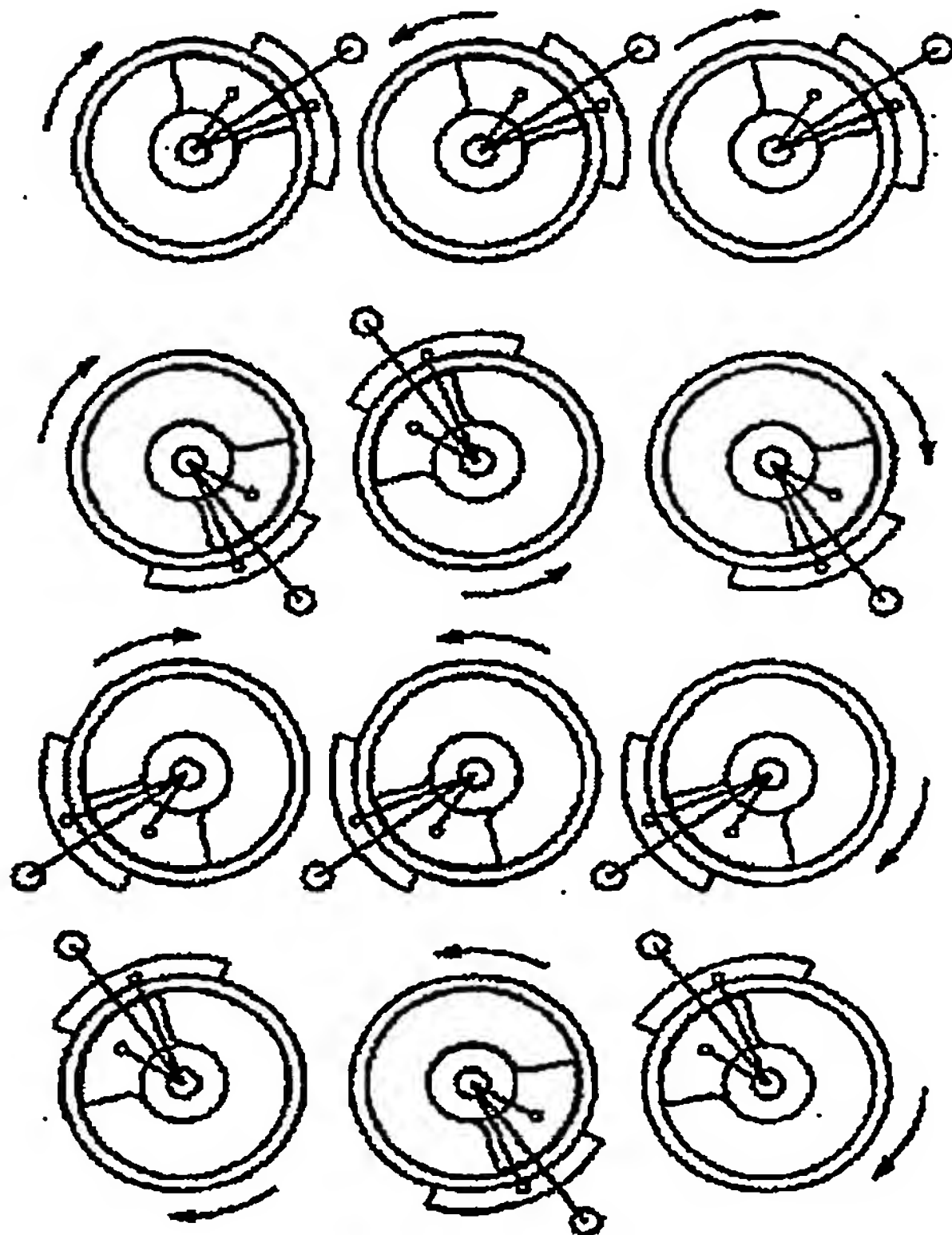
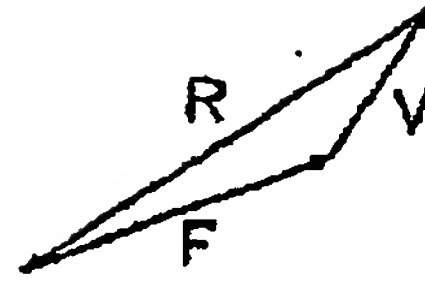


Fig. 8b

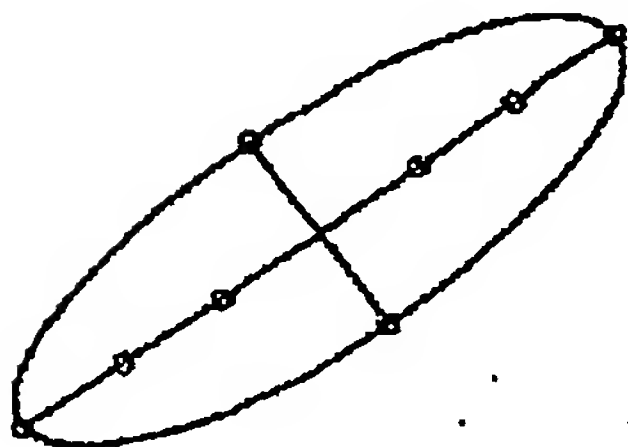
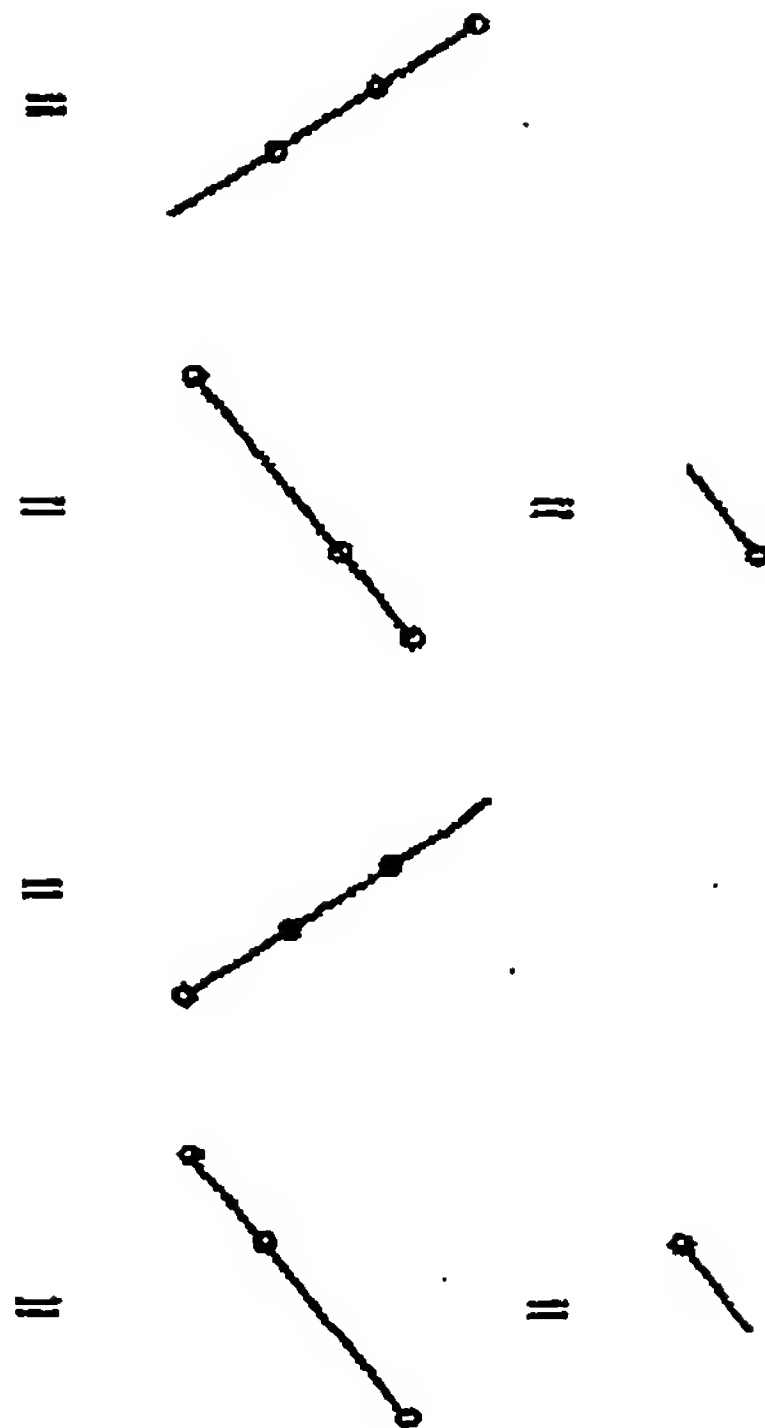


Fig. 8c

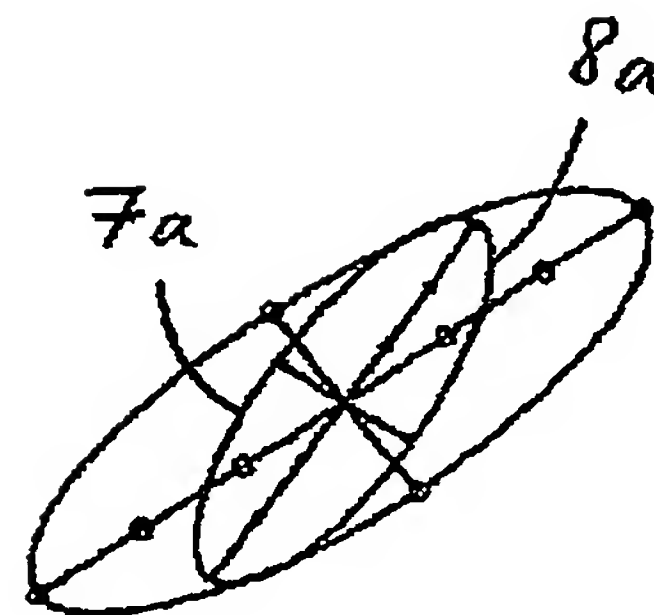


Fig. 8d

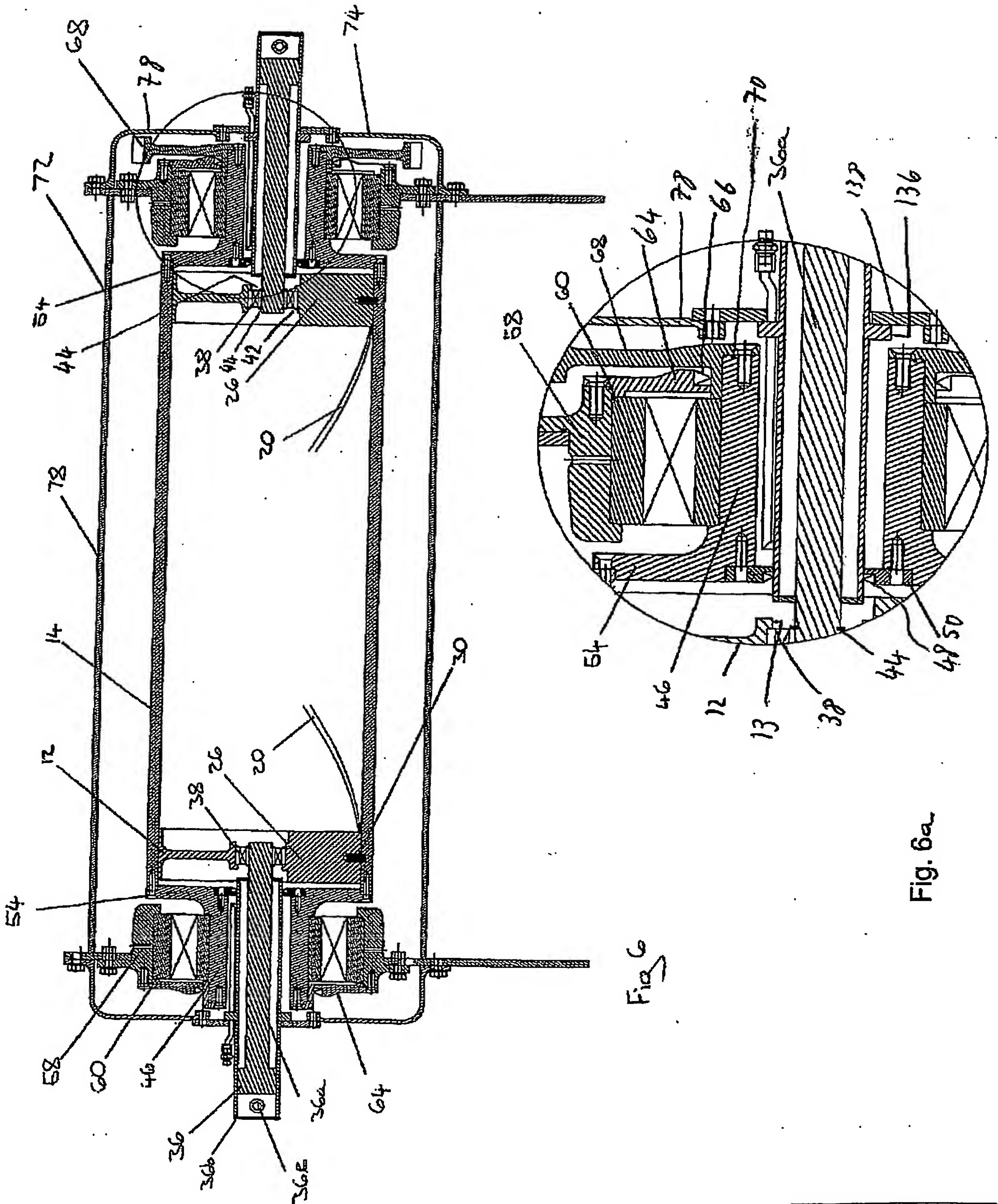


Fig. 6a

Fig. 6

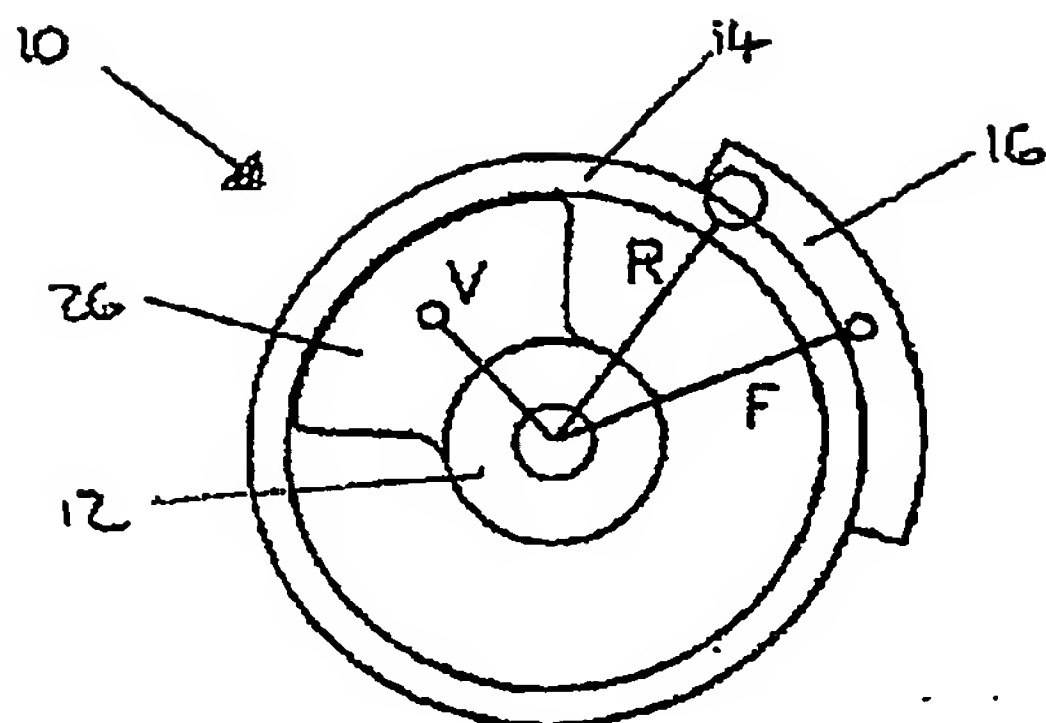


Fig. 7a

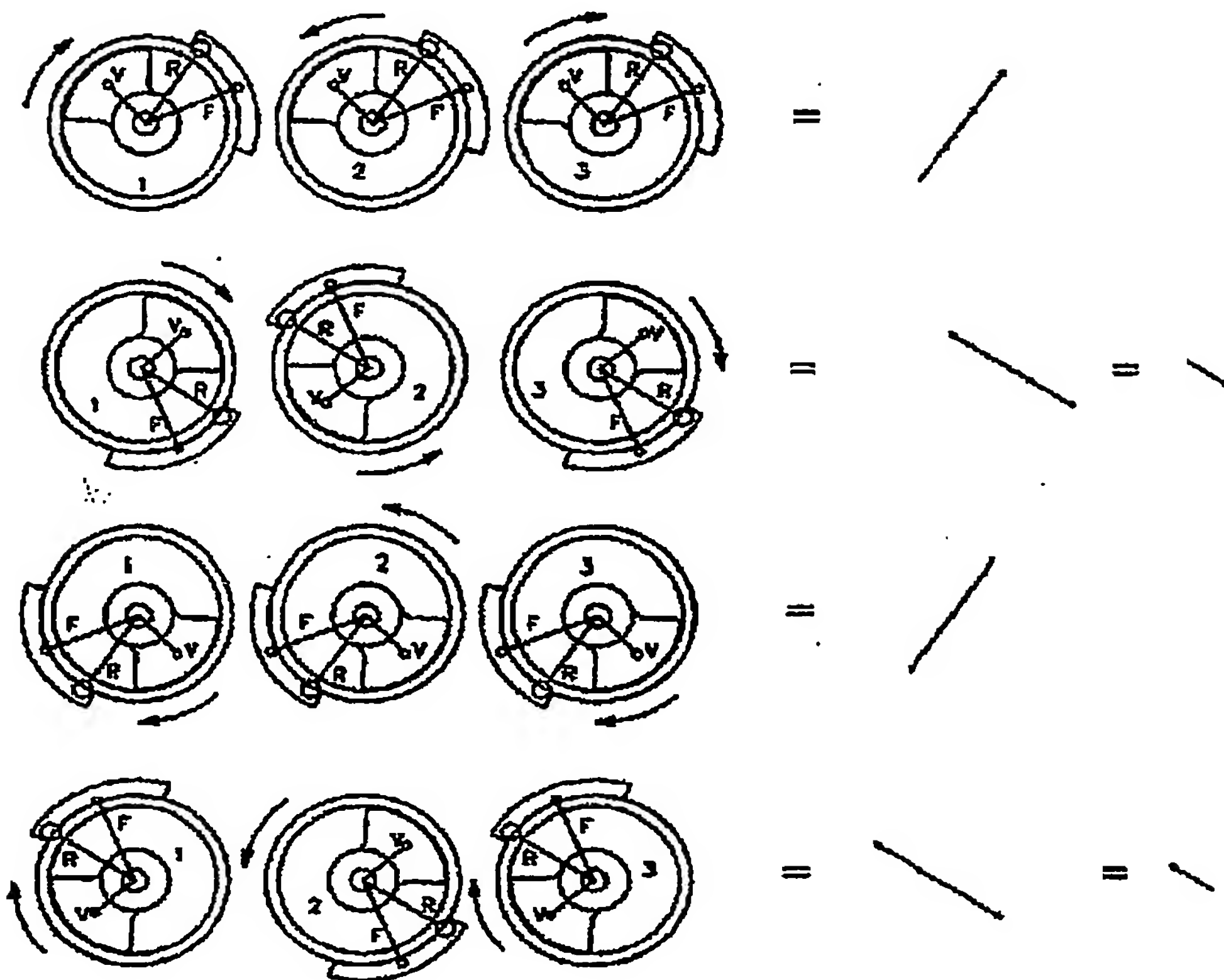
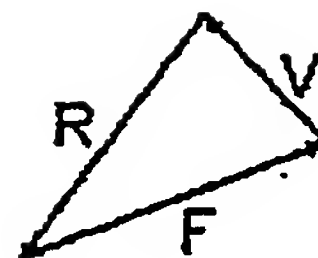


Fig. 7b

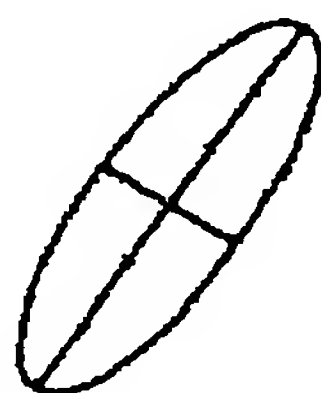


Fig. 7c

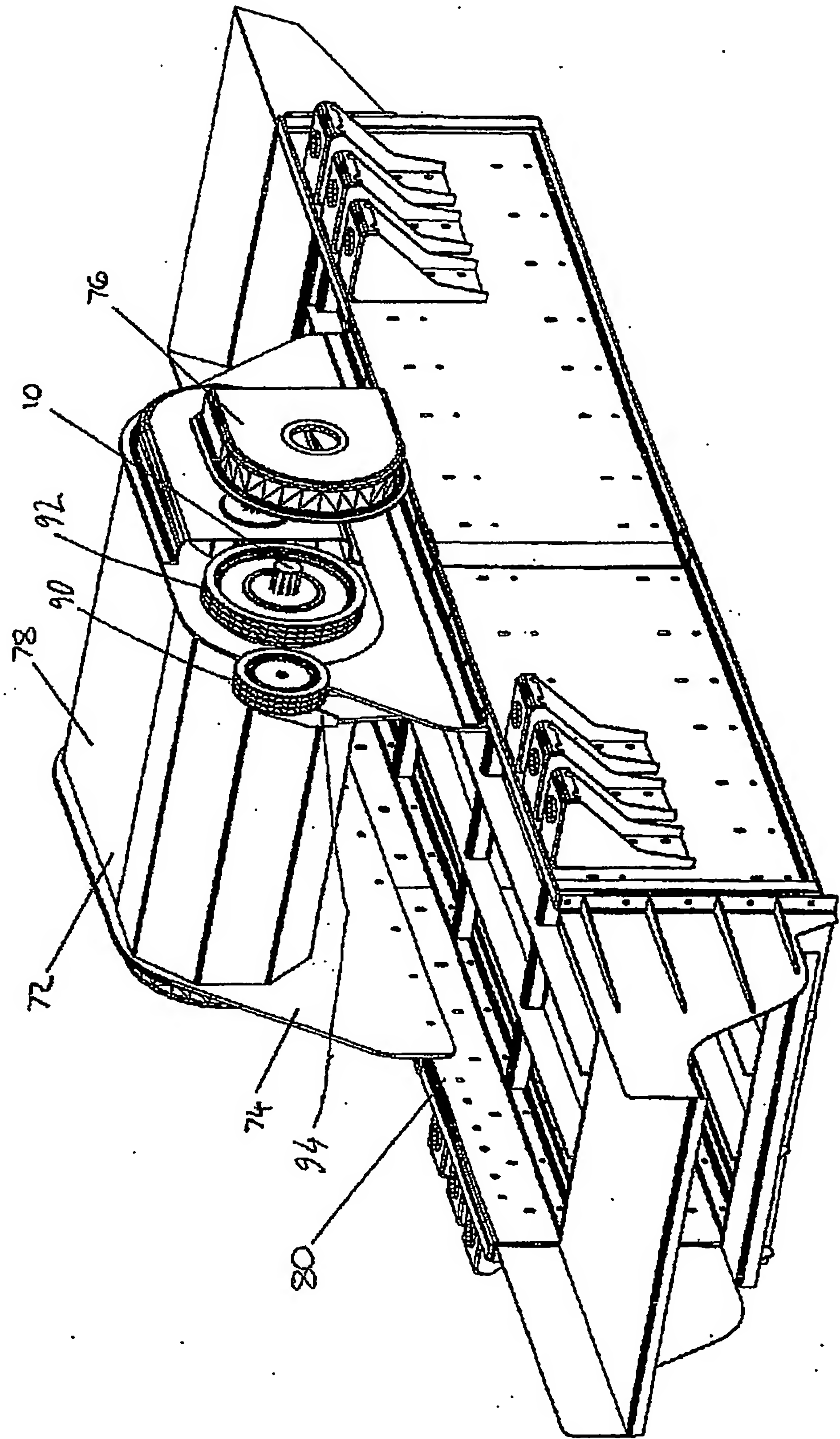


Fig. 9

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